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Suture after 10 weeks; Early restoration
of sensation and later of motion.*

BY

W. W. KEEN,

M. D. PROFESSOR OF SURGERY JEFFERSON MEDICAL COLLEGE PHILADELPHIA

and

WILLIAM G. SPILLER,

M. D. PROFESSOR OF THE DISEASES OF THE NERVOUS SYSTEM,

PHILADELPHIA POLYCLINIC



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WRIST-DROP *

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W. W. Keen,

M. D. Professor of Surgery Jefferson Medical College Philadelphia

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M. D. Professor of the Diseases of the Nervous System Philadelphia Polyclinic.

PROFESSOR KEEN'S SURGICAL REPORT.

Mr. A. J. R. aet. 43 of North Carolina first consulted me April 22nd, 1901.

Ten weeks ago he was thrown from a carriage and broke the left humerus at about the surgical neck. When the arm was taken out of the splints at the end of six weeks, the discovery was then first made that he had wrist-drop. This was complete, the hand hanging like a flail at right angles to the forearm.

On examination of the arm I confirmed the wrist-drop. I found an excellent apposition of the fragments of the humerus so much so that it was difficult to tell the exact level at which the fracture had taken place and that the musculo-spiral had been injured. Accordingly a skiagraph was taken which showed not only the fracture, but that the callus was very long but not so great in amount as to thicken the bone very greatly. This explained why it was difficult to determine the level at which the nerve had been injured by the fracture.

Operation April 23rd, 1901. I made an incision which finally extended from a little above the elbow well up toward the axilla at a slight angle to the line of the musculo-spiral nerve (Fig. 2). The skin was normal, but the moment that I reached the superficial fascia, I found that at the upper end of the incision it was very adherent to the tissues underneath. The same was true of the tissues all the way down to the bone. They were thoroughly bound together by adhesions. I found the very considerably thickened nerve under the supinator longus. It was nearly twice the ordinary thickness. Following it upwards, I found that it was very adherent to the bone, being bound down in a distinct adventitious sheath of connective tissue, which was more pronounced and as thick as, or possibly, thicker, than the sheath of the femoral artery. Finally at about the level of the posterior axillary fold, I was obliged to make a transverse incision posteriorly so as to reach the nerve sufficiently high up to get above the site of the injury. This carried me very near to the bifurcation of the posterior cord of the brachial plexus in the axilla. I found at this point that the nerve suddenly narrowed to its ordinary size and also became soft and normal to the touch when seized between the finger and thumb. Just at the point where this narrowing took place, there was an indurated spot in the nerve and from there on downward nearly to the elbow, the nerve was nearly double its size and very hard and brawny, feeling like a large vas deferens. Evidently the mechanism of the injury was as follows: — when the humerus broke, the ends of the bone lacerated the tissues all the way out to, but not through, the skin. This accounted for the adhesions even so distant as the superficial fascia. The nerve was not torn in two, but crushed in its sheath at the point of induration. Later inflammation and degenerative changes produced the great thickening of the nerve nearly to the elbow. It was perfectly evident that I could by no possibility remove all of the diseased nerve and yet suture the ends together. Accordingly, having loosened the nerve from its bed, I wrapped some gaenze around the nerve and then seizing it by the finger and thumb, stretched first one end and then the other till I obtained a considerable slack in the nerve. This stretching of the nerve before its division has very obvious advantages, for after the nerve is divided, seizing the extremity

with the finger and thumb and *a fortiori* by any instrument would require more force and do more mechanical violence than the method I adopted. The overlapping of the nerve also gave me the measure of how much I could remove. After removal, the piece excised measured 3.7 cm. The nerve was then sutured with silk, passed directly through the nerve. After tying a few vessels, the wound was closed with a small drainage tube at each end. The only vessel that gave any trouble was the posterior circumflex.

The patient's highest temperature after the operation was 99° F. He left the hospital one week after the operation, the wound being entirely healed. On the next morning after the operation, there was distinct improvement in the area of radial sensation. By the third day the light touch of a single hair over these fingers was felt. No motion, however had been acquired by the time he left.

Soon after the operation, I went away for a long absence. Mr. R. came to Philadelphia on January 10th, 1902, nine months after the operation and saw Dr. Wharton Sinkler. At that date sensation was perfect but there was still complete wrist-drop while flexion of the fingers and wrist, and pronation and supination of the hand were perfect. There was no response to the faradic current. While the muscles responded to a strong galvanic current, there was marked quantitative loss, but no reaction of degeneration. Mr. R. was directed to use the galvanic current daily for 10 to 15 minutes with injections of 1/20 gr. of strychnine into the extensors three times a week.

He consulted me again on February 10th, 1903, and I was quite astonished at the result. Sensation is perfect and as to motion, he has a perfectly useful hand (Figs. 1 and 2); the only defect is that while extension at the wrist alone is perfect, and normal in degree, and extension of the fingers alone is equally good, if he tries to extend both fingers and wrist, he has only about 75 to 80 % of the full range of motion for the combined extension. He tells me that for about three or four months he kept up the use of the galvanic battery and for some time the injections of strychnine as recommended by Dr. Sinkler, but that he has not used either for a long while. Strange to say the electrical reactions at the present time are practically un-

changed since January 1902 except that the extensors do react to a strong faradic current. But to accomplish this the current has to be so strong that it causes contraction of the flexors also. The restoration of voluntary control therefore is far better than of electrical control of the extensor muscles.

The very early return of sensation in this case corresponds to the observation of many surgeons in similar cases. It will be observed, however, that while the operation was done April 23rd, 1901, the patient did not begin the use of electricity for about



Fig. 1. — Hand in flexion.



Fig. 2. — Hand in extension after operation.

nine months after the operation and over a year after the accident, though I had strongly recommended it at the time of operation. Thirteen months later, following the late use of electricity and strychnine, there was practically complete restoration of function in the extensor muscles. As the photographs show, complete extension both of wrist and fingers at the same time is not yet possible, but the hand for all practical purposes is as useful as ever.

That there should have been *any* and especially almost com-



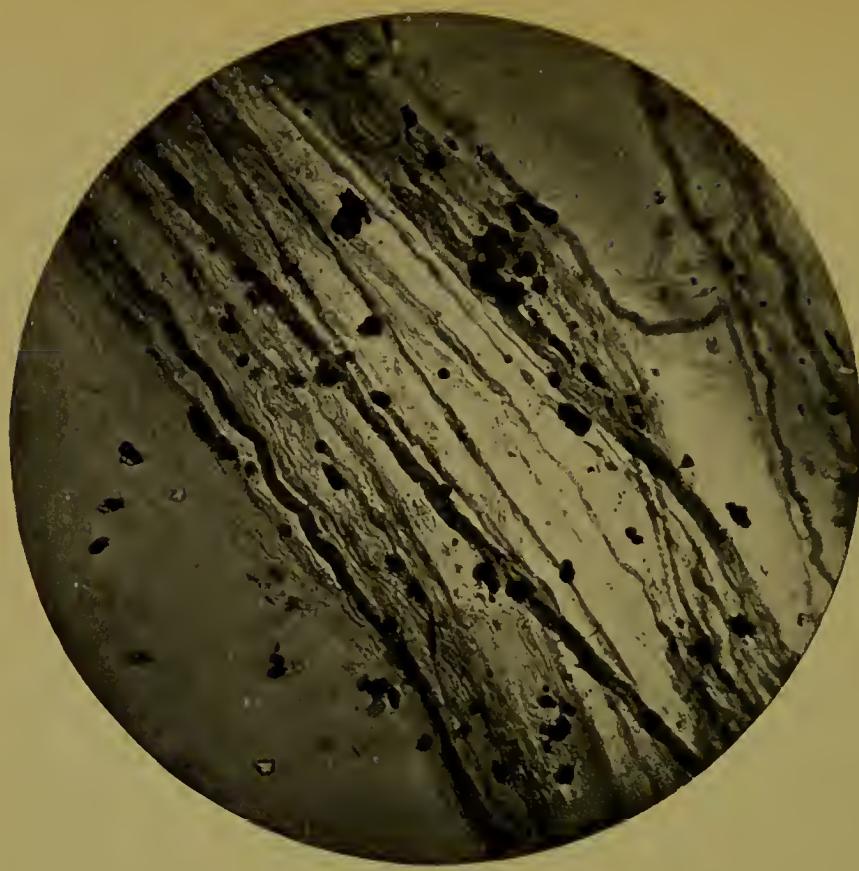


Fig. 3. — Teased preparation (osmic acid stain) from the distal end of the portion of nerve resected. The myeline remaining in the nerve sheaths is shown as black masses. The rest of the myeline has disappeared and the nerve bundles are intensely degenerated.



Fig. 4. — Transverse section from the distal end of the portion of nerve resected. The connective tissue about the nerve bundles is greatly increased in amount and only a few medullated nerve fibres are seen within the nerve bundles (better shown in one of the two nerve bundles than in the other). In reality a few more medullated fibres are found in the section than are represented in the photograph.

plete restoration of function is most encouraging in view of the very extensive disease of the nerve. This extended almost from the axilla to the elbow and precluded any possibility of excising all of the diseased nerve. Only a small portion was excised (and as Prof. Spiller's report shows this was most profoundly degenerated) yet the functional result is all that could be desired.

In the *Manchester Medical Chronicle* for August 1900, I have published six similar cases of wrist-drop. That paper has been published by M. Chipault also in his *Etat actuel de la chirurgie nerveuse*.

PROFESSOR SPILLER'S PATHOLOGICAL REPORT.

Transverse sections from the lower end of the portion of nerve resected are much degenerated, as shown by the Weigert hematoxylin method. The fibrous sheaths are thick, and a large amount of connective tissue is found around and between the nerve bundles. The walls of the blood vessels in the nerve are also thickened. Portions of nerve fibers from the lower end of the piece of nerve removed, teased and stained with 1% osmic acid solution (Fig. 3), give a better idea of the degree of degeneration than do transverse sections (Fig. 4) cut with the microtome and stained with Weigert's hematoxylin. In the osmic acid preparations the nerve fibers appear *intensely* degenerated, and the myelin instead of appearing as sheaths about the nerve fibers is broken into many round masses.

Transverse sections from the upper end of the portion of nerve removed also show much degeneration, but while the degeneration is very marked in some bundles, in others the nerve fibers appear nearly normal. There is much increase of fibrous connective tissue in and about the bundles. The nerve fibers from the upper end of the piece of nerve removed are much less altered in osmic acid preparations than are the nerve fibers from the lower end.

In longitudinal sections through the nodular portion of the piece of nerve removed, the nodular swelling is shown to be the result of the formation of fibrous connective tissue within the nerve.

Paralysie radiale consécutive à une fracture de l'humérus ayant blessé le nerf. Suture après 10 semaines. Retour rapide de la sensibilité, retour plus tardif de la motilité. — Homme atteint de fracture du col chirurgical de l'humérus. 10 semaines après, en enlevant l'appareil, on constate que la main pend comme un fléau, à angle droit sur l'avant-bras.

K. découvrit le nerf radial, qui était épaissi sur une grande étendue, et adhérant aux tissus voisins. Le nerf n'avait pas été divisé, mais écrasé par les fragments, d'où névrite et dégénérescence jusqu'au conde.

K. commença par élonger le nerf, de manière à pouvoir réséquer 3,7 cm. de sa longueur, et rénir les bouts par une sutre perforante à la soie.

Dès le lendemain, retour de la sensibilité. Retour beaucoup plus lent de la motilité. 9 mois après l'opération, il y avait flexion des doigts et pronation et supination, mais toujours pas d'extension du poignet. Ce n'est qu'après environ 2 ans, que la main avait recouvré tous ses mouvements, sauf l'extension simultanée du poignet et des doigts.

La résection d'une petite portion du nerf, dégénéré sur une grande étendue, avait donc suffi au retour des fonctions.

Radialislähmung in Folge einer Verletzung des Nerven durch Humerusfractur. Naht 10 Wochen später. Rasche Rückkehr der Sensibilität, spätere der Motilität. — Bruch des chirurgischen Halses des Humerus beim Manne. Nach 10 Wochen, erst beim Abnehmen des Apparates, findet man, dass die Hand wie ein Dreschflegel rechtwinklig auf den Vorderarm herabhängt.

K. legte den N. radialis bloss; derselbe war, auf eine grosse Strecke weit verdickt und mit den umgebenden Geweben verwachsen. Der Nerv war nicht getrennt, sondern durch die Bruchenden zerquetscht, woher Neuritis und Entartung bis zum Ellbogen entstanden war.

Der Nerv wurde zuerst von K. soweit ansgezogen, dass die Resection eines Stückes von 3,7 ctm. unternommen werden konnte. Alsdann Vereinigung der Endstücke vermittelst perforirender Sutur mit Seide.

Vom folgenden Tage an, kehrte die Sensibilität zurück, die Motilität aber viel später. 9 Monate nach der Operation war die Beugung der Finger, sowie die Pronation und Supination vorhanden, aber das Handgelenk blieb gebogen. Erst nach etwa 2 Jahren, hatte die Hand alle ihre Bewegungen, die gleichzeitige Extension des Handgelenks und der Finger ausgenommen, wieder erlangt.

Die Resection eines kleinen Stückes des weitläufig entarteten Nerven genügte also zur Rückkehr der Funetion.

Paralisi radiale da frattura dell' omero con ferita del nervo. Sutura nervosa dopo 10 settimane. Ritorno rapido della sensibilità, e tardivo della motilità. — In un uomo colpito da frattura del collo chirurgico dell' omero, si constata alla rimozione dell' apparecchio, dopo 10 settimane, che la mano cade inerte nel polso ad angolo retto coll' avambraccio.

K. prepara il nervo radiale, che era ingrossato per lungo tratto ed aderente ai tessuti vicini. Esso non era stato diviso, ma schiacciato dai frammenti, con produzione di nevrite, e degenerazione fino a livello del gomito.

Dopo averlo allungato con trazione, in modo da poterlo resecare, K. asportò in lunghezza cm. 3, 7 del nervo, e ne riunì i monconi con sutura perforante di seta.

Fin dal giorno dopo, era ritornata la sensibilità. La motilità invece venne assai più tardi. Nove mesi dopo l'operazione, era possibile la flessione delle dita, la pronazione e la supinazione ma il polso era sempre flesso. Solo dopo due anni la mano aveva recuperato tutti i movimenti, salvo l'estensione simultanea nel polso e nelle dita.

Conchiude che la resezione di breve porzione del nervo, estesamente degenerato era bastata al ritorno delle funzioni.

Parálisis radial, consecutiva á una fractura del húmero con herida del nervio. Sutura 10 semanas mas tarde. Reaparición rápida de la sensibilidad y reaparición algo mas lenta de la motilidad. — Hombre que ha sufrido una fractura del cuello quirúrgico del húmero. A las 10 semanas, al levantar el apósito, se observa que la mano cuelga pélvula formando un ángulo recto con el antebrazo.

K. puso á desubierto el nervio radial que se hallaba engrosado en una gran extensión y que adhería á los tegidos vecinos. El nervio no había sido seccionado pero si aplastado por los fragmentos óseos, en virtud de lo cual se desarrolló una neuritis y degeneración del nervio hasta el eodo.

K. empezó por alargar el nervio de modo que fuera posible resear 3,7 cm y unir sus bordes por medio de una sutura perforante con seda.

A partir del dia siguiente, reaparición de la sensibilidad. Reaparición mucho mas lenta de la motilidad. 9 meses tras la operación, la flexión de los dedos era practicable y lo mismo la pronación y supinación de la mano, pero esta se mantenía siempre en flexión. Solo á los dos años recuperó la mano todos sus movimientos excepto la extensión simultanea de los dedos y de la mano.

Así pues, la resección de una pequeña porción de nervio degenerado en gran extensión había bastado para producir la reaparición de las funciones.
